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ABSTRACT

A survey questionnaire, directed to determining maintenance administrative ratios, was mailed to 3,685 nation-wide companies. Of the 509 responses, 502 were sufficiently complete to use in the study. The survey data are presented in the form of charts and tables, grouping the companies by the type of manufacturing reported. Each data table is prefaced by a discussion of the factors related to the ratio and is followed by a brief analysis of findings. The survey presents a profile of reporting companies (total number of employees, type of manufacturing, mergers and austerity programs). Data are then presented on: the number of total plant employees per maintenance employee, the number of maintenance hourly employees per maintenance supervisor, the number of maintenance hourly employees per maintenance staff planner, how maintenance work is measured, time spent on construction and alterations, length of training program for hourly maintenance personnel, the use of special technicians and industrial engineers in maintenance, the ratio of maintenance hourly employees to special technicians and to industrial engineers, the number of maintenance hourly employees per stores employee, and the number of maintenance hourly employees per maintenance staff employee. (AG)

HOW OVER 500 FIRMS MANAGE THE MAINTENANCE FORCE

Summary Report of a Survey of Maintenance Administrative Ratios

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Preface

This report, prepared by Albert Ramond and Associates, Inc., summarizes the data as reported by the companies participating in the Maintenance Administrative Ratios Survey conducted earlier this year. This data for each company reported herein has been maintained on a confidential basis so that the information for any specific company cannot be identified.

METHOD

Survey questionnaries were mailed to 3,685 nation-wide companies and 509 replies were received. These returns were reviewed for completeness and 502 companies, representing 748,745 employees, were finally selected. The screened returns were then coded and forwarded to a service bureau which tabulated the data provided in the report.

The ratios in this report are average ratios weighted by the number of firms reporting.

FORMAT

The participating companies have been grouped by type of manufacturing reported. For convenience, data has been provided separately for ten industries representing the largest number of returns. Each data table is prefaced by a discussion of the factors relating to the ratio and followed by a brief analysis of findings. Participating companies are encouraged to interpret the data in terms of their particular company and industry.

OVERVIEW

It is the intent of this survey to provide to operating management "guidelines" for maintenance operations based on current industry practices. Judgments regarding the efficiency or effectiveness of maintenance activities among the industries cannot be made, and it should be remembered that the data in this report identifies present operating conditions and not the *attainable* levels of maintenance performance.

To provide a basic orientation to this report, the following are the average characteristics of the typical company participating in the survey:

Average Participating Company

Total Plant Employees:	1,093
Maintenance Craft and Trades Hourly:	6% of Total Plant Employees
Maintenance Staff Employees:	7% of Maintenance Hourly Force
Storekeeping Personnel:	3% of Maintenance Hourly Employees
Construction and Alterations Work:	23% of Total Maintenance Man-Hours
Special Maintenance Technicians:	3% of Total Maintenance Hourly Manpower
Maintenance Planners:	4% of Maintenance Hourly Force
Apprenticeship Program:	Not Used
Industrial Engineers in Maintenance:	Not Used
Type of Measurement:	Estimates
Mergers and Acquisitions:	None in The Last Three Years
Austerity Programs:	None in The Last Three Years

Albert Ramond and Associates, Inc.
Survey of Maintenance Administrative Ratios

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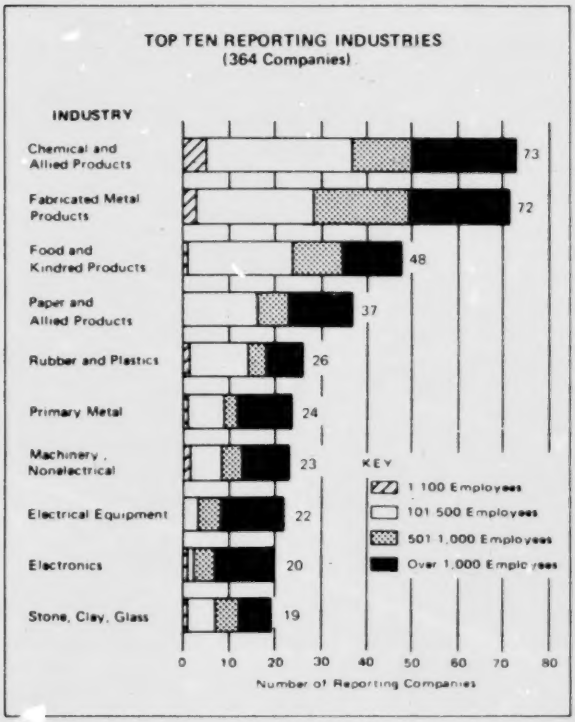
I. Profile of Reporting Companies

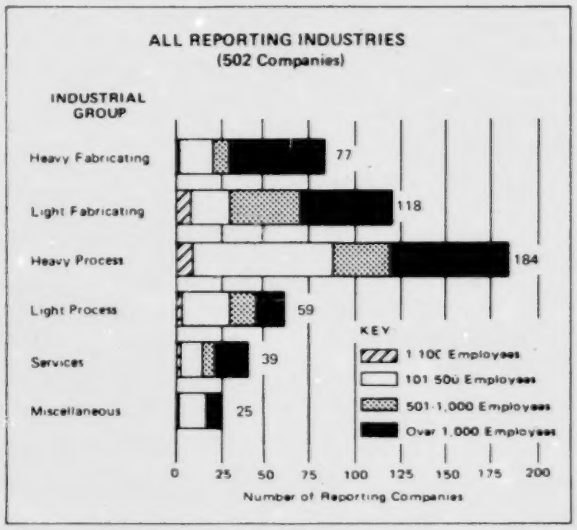
SCOPE

The participating companies have been grouped according to type of manufacturing reported. The industry groupings shown in the following graphs have been used consistently in the data presented in this report. When the data is provided for a small number of companies, the information may be of interest, but should not be used as typical of company practice in that industry or industrial group.

DATA

Distribution of Reporting Companies by Industry and Number of Total Plant Employees





Composition of Industrial Groups by Industry and Number of Companies Reporting

Heavy Fabricating (77) – Electrical Equipment (22); Aerospace (12); Machinery Nonelectrical (23); Transportation Equipment (13); Ordnance (1); Lumber-Wood (6).

Light Fabricating (118) – Fabricated Metal Products (72); Printing (11); Leather (4); Furniture (3); Electronics (20); Instruments–Cameras (8).

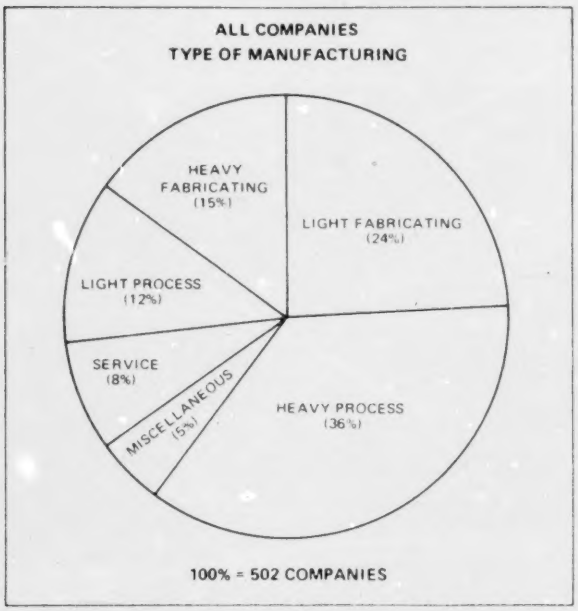
Heavy Process (184) – Chemicals (73); Paper (37); Rubber (26); Primary Metal (24); Stone, Clay, Glass (19); Petroleum (5).

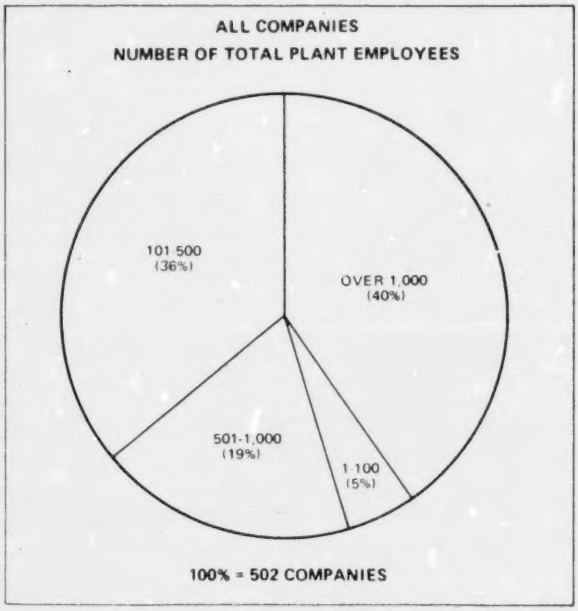
Light Process (50) – Foods (48); Textiles (7); Apparel (3); Tobacco (1).

Services (39) – Hospitals (6); Education (5); Government (5); Entertainment (1); Navy-Air Force Base (4); Office Buildings (3); Airlines (1); Research-Science (14).

Miscellaneous (25) – Industries were not identified.

Distribution of Reporting Companies by Type of Manufacturing and Number of Total Plant Employees





ANALYSIS

The ratios and other data contained in the balance of the report have been computed as weighted averages based on the number of firms reporting in either an industry or industrial group. An individual company should, therefore, consider its relative ranking in the industrial groups, regarding type of manufacturing and number of employees, prior to relating the guidelines to its maintenance operations. A company with under 100 total plant employees should, for example, consider the fact that 95% of the companies in our sample had over 100 employees. Practices may differ substantially by plant size even in the same industry.

Within the major industrial groups, a single industry may dominate the average ratio. In the Light Fabricating group, for example, the Fabricated Metal Products industry consittutes 61% of the total number of firms in the group. Maintenance practices in the Instruments–Cameras industry will have only one-ninth the weighting of Fabricated Metal Products in the group average.

MERGERS AND AUSTERITY PROGRAMS (Optional questions on survey questionnaire)

Of the participating companies, 146 (30%) have been involved in a merger or acquisition in the past three years. Of the 146 positive replies, 126 (86%) reported no change in the maintenance administrative staff, with 13 (9%) reporting an increase and 7 (5%) reporting a decrease.

The reported effect of mergers on maintenance supervision is roughly the same. Of the 146 positive responses, 127 (87%) reported no change with 15 (10%) reporting an increase in the number of supervisors, and 4 (3%) reporting a decrease.

The effect of austerity programs on maintenance, production and salaried employees cannot be judged with precision from the reports received. Many respondents indicated that they did not know the effect of austerity programs on production or salaried employees. It is also apparent from the returns that some austerity programs were directed at costs other than labor.

153 (31%) of the participating companies reported some form of austerity program in the last three years. The severity of cutbacks ranges from 50% to 0% with 20% a common figure.

The survey shows layoffs or transfers of personnel occurring most frequently in the Food, Chemical, Metal Fabricating, and Electronic industries, but considering the small number of returns, conclusions are difficult to make.

II. Maintenance Manpower Requirements

SCOPE

The size of the maintenance force in relation to total plant employment is determined by a large number of complex variables. Consideration must be given to factors such as the age and complexity of equipment in the plant, the economic importance of production downtime and management's policies regarding the level or quality of maintenance activity that is desired. The guidelines presented here should, therefore, be interpreted by an individual company in terms of its own particular situation.

The following graphs present the average ratios, by industry, of the number of Total Plant Employees per Maintenance Hourly Employee. The Total Plant Employee category includes management, supervisory and technical employees with the maintenance hourly classification including all craft and trades personnel but excluding janitorial and utilities employees.

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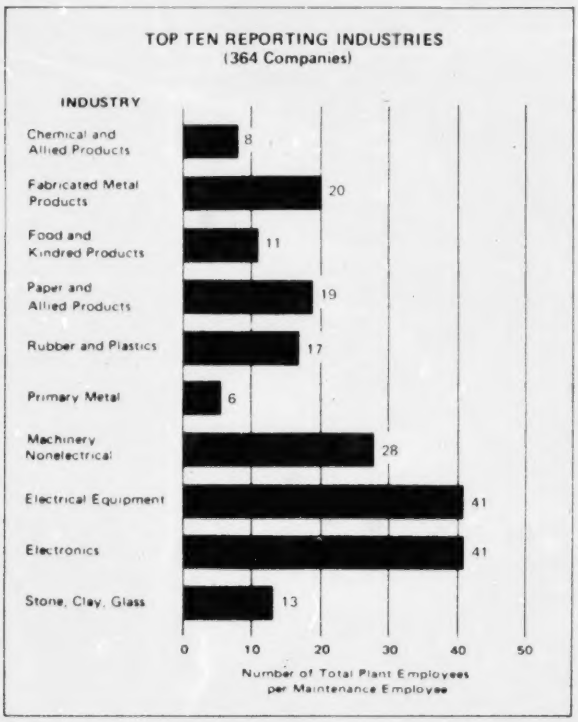

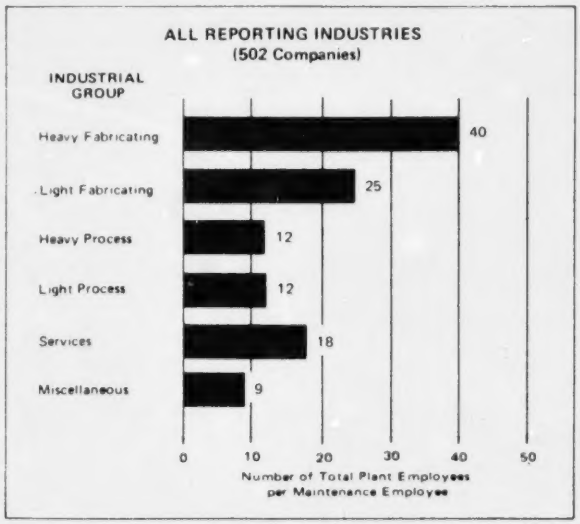

ANALYSIS

For all companies responding to the survey, the average ratio of Total Plant Employees to Maintenance Hourly Employees is 17:1. Expressed differently, this means that 6% of Total Plant Employees are Maintenance Hourly Personnel. There is a significant variation between industrial groups with the process industries reporting over twice as many maintenance employees relative to total employment compared to the fabricating group. By industries, the variation is even more pronounced, ranging from 6:1 for Primary Metal to 41:1 for the Electronics and Electrical Equipment Industries.

The wide variations in the ratio appear to be directly related to the degree of mechanization present in each industry. The Process industries, where large amounts of capital equipment have been substituted for direct labor, require more maintenance men to service the equipment. Additionally, the high cost of production downtime, coupled with the intensive, round-the-clock operation of expensive automated equipment, makes deferred maintenance uneconomical. Maintenance manpower must be available on each shift if excessive downtime costs are to be avoided.

III. Supervising the Maintenance Force

SCOPE

The number of maintenance employees a supervisor can effectively control is to a large degree determined by the nature of the maintenance department organization. In companies where supervisors are required to plan and schedule the work, oversee craft training efforts and monitor direct labor performance, the ratio of hourly employees per supervisor will be lower than the ratio in companies where management has established maintenance staff functions to provide these necessary services. The skill level of the maintenance hourly force and the physical plant area must also be considered when determining the proper hourly to supervisory ratio for an individual company.

The following graphs present the average ratios, by industry, of the number of hourly maintenance employees per supervisor. The maintenance hourly classification includes all craft and trades employees (excluding utilities and janitorial personnel). The supervisory category includes all foremen and first-line supervisors engaged in controlling the maintenance hourly force with the exception of working lead men or crew leaders.

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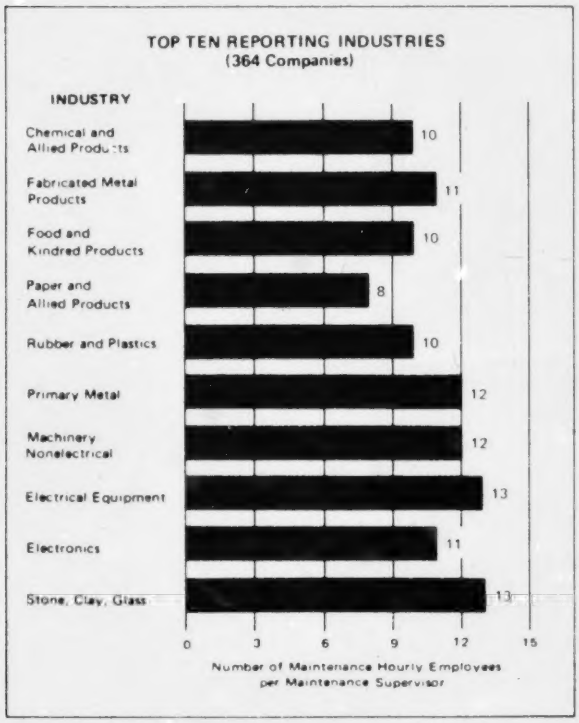
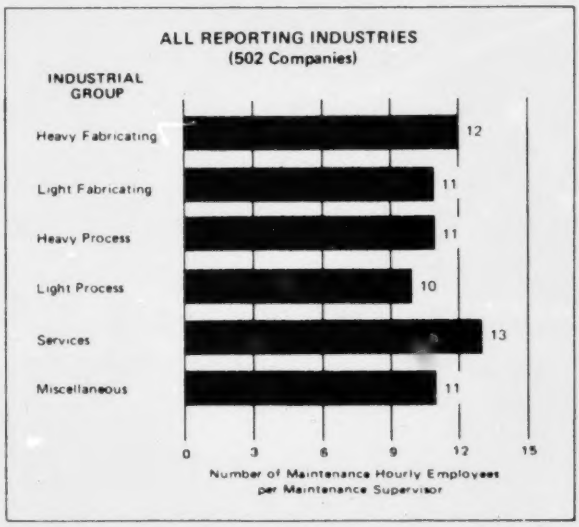




ANALYSIS

For all reporting industries, the average ratio of maintenance hourly employees per supervisor is 11:1. There is a slight variation in the ratio among the various industries ranging from 8:1 in Paper and Allied Products to 13:1 for the Electrical Equipment and Stone, Clay and Glass industries. There is no significant variation in the ratio among industrial groups based on type of manufacture.

It is interesting to note that in production departments, an hourly to supervisory ratio of 20:1 or greater is not uncommon. This may be attributed to the fact that for years management has recognized the need and provided extensive staff support to production supervisors in the areas of production planning and control, scheduling, estimating, and work measurement systems. The maintenance supervisor, however, has, in most cases, not been provided with the equivalent staff support and as a result can effectively control fewer hourly employees than his counterpart in production.

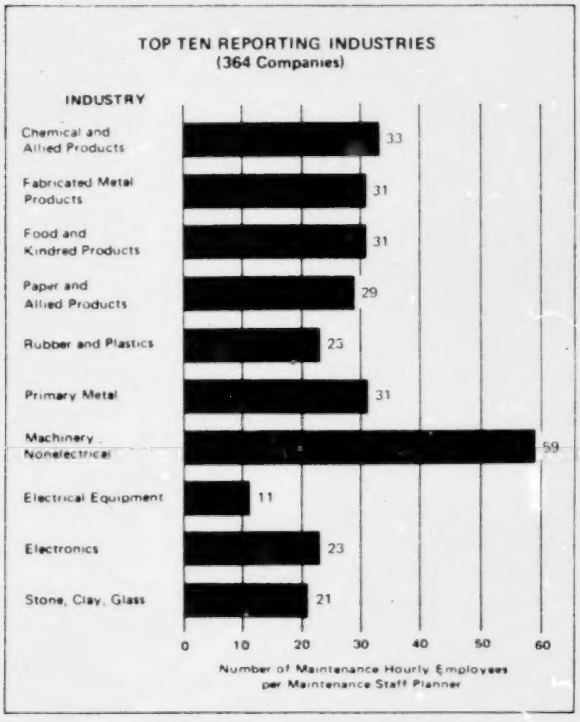
IV. Planning Maintenance Work

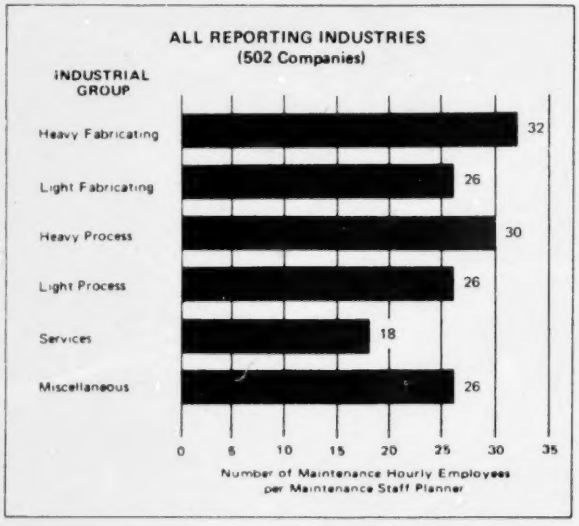
SCOPE

The general term "Maintenance Planning" actually includes three basic kinds of planning: long-range, short-range and job planning. Long-range planning is typically concerned with major equipment and facility requirements from one to ten years in the future. Short-range planning refers to activities such as furnace rebuilds or major machinery overhauls that are cyclical in nature and will be required within a one year period. Job planning, as a staff function, is a relatively recent development and refers to the very short term detailing of maintenance jobs for hourly craft and trades personnel.

The following graphs present the average ratio of the number of maintenance hourly employees per maintenance staff planner. The maintenance staff planner classification includes all personnel in staff capacities who plan maintenance work excluding planning that is performed on a part-time basis by maintenance supervisors. The maintenance hourly classification includes all hourly craft and trades personnel (excluding utilities and janitorial employees).

DATA





ANALYSIS

For all reporting industries, the average ratio of maintenance hourly employees to maintenance staff planners is 28:1. There is a wide variation in the ratio among industries ranging from 11:1 for Electrical Equipment to 59:1 for the Non-electrical Equipment industry. It is important to note that the limited scope of this survey did not permit the separation of the total planning effort into its three basic types. The significant variation in the ratio among industries may, therefore, be attributed to the different types of planning that is performed. Companies which perform mostly long- and short-range planning will have a much higher ratio of hourly employees per planner than companies where detailed job planning is a standard practice.

It has been our experience that while many companies do long- and short-range planning, job planning is a new concept and is not yet a widespread practice. For companies who do detailed job planning, the above ratios will appear rather high and should be adjusted accordingly.

V. Measuring Maintenance Work

SCOPE

Many techniques for measuring and controlling maintenance activities are presently available to management. There is, however, a considerable variation in the accuracy achieved by the various techniques ranging from rough job estimates prepared by hourly craftsmen to detailed work standards based on engineered standard data. Any company, when selecting a particular technique, must examine the nature of its maintenance work, the information available about the work, and the end use or purpose of the measurement system.

The cost benefits achieved by implementing a well-designed, effective maintenance work measurement program can be quite dramatic. In companies without a measurement and control program, maintenance labor performance is generally found to be 50% to 60% of a Fair Day's Work level–sometimes even less. The implementation of an effective measurement program often boosts this performance up to 75% to 80%. In terms of manpower, this means accomplishing the same amount of work with one-fifth to one-third fewer employees.

The following tables show the type of measurement presently being used by the companies responding to the survey. Many companies reported use of several techniques and as a result percentages will not necessarily add to 100%.

DATA

Top Ten Reporting Industries (364 Companies)

Industry	No Measurement Used	Estimates	Work Sampling	Standards	Slotting	Other
Chemical and Allied Products	16%	84%	20%	13%	8%	10%
Fabricated Metal Products	12%	83%	5%	13%	3%	19%
Food and Kindred Products	10%	66%	9%	21%	7%	28%
Paper and Allied Products	11%	88%	6%	21%	6%	15%
Rubber and Plastics	19%	81%	5%	10%	10%	19%
Primary Metal	12%	81%	14%	19%	19%	5%
Machinery, Nonelectrical	9%	81%	0%	19%	5%	10%
Electrical Equipment	23%	88%	12%	12%	6%	24%
Electronics	10%	83%	0%	33%	11%	6%
Stone, Clay, Glass	10%	82%	6%	12%	6%	6%
Average – All Groups	14%	82%	14%	19%	9%	19%

Type of Measurement used–
Percent of Firms Reporting

All Reporting Industries (502 Companies)

Industrial Group	No Measurement Used	Estimates	Work Sampling	Standards	Slotting	Other
Heavy Fabricating	14%	85%	8%	23%	6%	11%
Light Fabricating	14%	72%	3%	25%	5%	13%
Heavy Process	15%	83%	12%	15%	9%	11%
Light Process	14%	67%	12%	22%	10%	27%
Services	8%	61%	14%	33%	14%	14%
Miscellaneous	20%	65%	10%	20%	0%	25%
Average – All Groups	14%	79%	9%	19%	8%	15%

Type of Measurement used–
Percent of Firms Reporting

ANALYSIS

It is apparent from the data that the overwhelming majority of reporting companies rely upon job estimates for measuring maintenance work. Estimates are the simplest and least costly method of measurement and can be readily implemented. The estimates approach, however, typically results in only a minor improvement in work performance. Estimates are usually based on either existing levels of performance or historical data rather than *attainable* levels of performance. In addition, all estimates have the inherent weakness of inconsistency.

VI. Construction and Alterations Requirements

SCOPE

Maintenance managers are being more and more frequently asked by management to compete with outside contractors on construction and alteration projects. Soaring contractor costs, as well as major communication difficulties between company design engineers and contractors, make "doing it ourselves" appear relatively attractive.

Management, however, must remember that the prime objective of the maintenance department is the preservation of plant facilities and equipment at the lowest possible cost. Construction and alterations requirements must not affect the quality of normal maintenance activities. Conventional "make" or "buy" analysis should be applied to construction projects and factors such as skills required, availability of manpower and schedule compliance must be considered as part of the total costs.

The following tables present the average percent of total maintenance man-hours devoted to construction and alteration projects by the companies participating in our survey.

DATA

Top Ten Reporting Industries (364 Companies)

Industry	Industry Average	0%	10%	20%	30%	40%	Over 50%
Chemical and Allied Products	22%	3%	30%	28%	25%	11%	3%
Fabricated Metal Products	22%	8%	25%	37%	15%	7%	8%
Food and Kindred Products	22%	4%	38%	19%	23%	10%	6%
Paper and Allied Products	19%	11%	28%	38%	14%	3%	6%
Rubber and Plastics	21%	8%	20%	32%	32%	8%	0%
Primary Metal	15%	13%	33%	50%	4%	0%	0%
Machinery, Nonelectrical	24%	4%	26%	30%	22%	9%	9%
Electrical Equipment	32%	0%	9%	32%	27%	14%	18%
Electronics	38%	5%	5%	15%	15%	30%	30%
Stone, Clay, Glass	30%	0%	11%	22%	33%	28%	6%
Average – All Industries	23%	6%	26%	30%	21%	10%	7%

Percent of Work on Construction/Alterations
Percent of Companies Reporting

All Reporting Industries (502 Companies)

Industry	Industry Average	0%	10%	20%	30%	40%	Over 50%
Heavy Fabricating	25%	4%	22%	26%	24%	13%	11%
Light Fabricating	25%	8%	22%	30%	16%	13%	11%
Heavy Process	21%	6%	27%	34%	22%	8%	3%
Light Process	21%	5%	38%	20%	24%	8%	5%
Services	26%	8%	27%	24%	10%	13%	18%
Miscellaneous	26%	4%	16%	32%	20%	16%	12%
Average – All Groups	23%	6%	26%	29%	20%	11%	8%

Percent of Work on Construction/Alterations
Percent of Companies Reporting

ANALYSIS

For all reporting companies, 23% of total maintenance hours are spent on construction and alteration projects. There is a significant variation among industries, ranging from 15% in Primary Metal to 38% in the Electronics industry.

This variation may be attributed to the significantly different nature of construction projects in the two industries. Construction activities in the Electronics industry typically consist of a large number of small alterations projects which are very difficult to contract out. In Primary Metal, however, the projects are usually much more extensive, requiring large amounts of manpower on multiskilled operations.

VII. Training Hourly Maintenance Personnel

SCOPE

In many highly mechanized plants, the margins of profit and loss are, to a large extent, determined by the quality and effectiveness of maintenance. The dependability and availability of complex equipment are a function of how well the maintenance operations are performed. To ensure the continued effectiveness of maintenance in modern plants, whatever the size, the training of maintenance personnel is essential.

The following tables present the percentage of companies participating in the survey who use apprentice programs and the length of these programs when employed.

DATA

Top Ten Reporting Industries
(364 Companies)

Industry	No Program	2 Years	3 Years	4 Years	Other
Chemical and Allied Products	45%	12%	10%	32%	1%
Fabricated Metal Products	68%	11%	1%	19%	1%
Food and Kindred Products	54%	15%	4%	23%	4%
Paper and Allied Products	41%	5%	8%	38%	8%
Rubber and Plastics	80%	0%	4%	12%	4%
Primary Metal	29%	4%	17%	46%	4%
Machinery, Nonelectrical	87%	0%	4%	9%	0%
Electrical Equipment	77%	14%	0%	9%	0%
Electronics	85%	5%	5%	5%	0%
Stone, Clay, Glass	53%	5%	5%	37%	0%
Average – All Industries	58%	9%	6%	24%	3%

Length of Apprentice Program
Percent of Firms Reporting

All Reporting Industries
(502 Companies)

Industry	No Program	2 Years	3 Years	4 Years	Other
Heavy Fabricating	74%	7%	3%	12%	4%
Light Fabricating	67%	8%	2%	22%	1%
Heavy Process	48%	7%	10%	32%	3%
Light Process	57%	15%	3%	22%	3%
Services	78%	3%	3%	13%	3%
Miscellaneous	64%	8%	12%	16%	0%
Average – All Groups	61%	8%	6%	23%	2%

Length of Apprentice Program
Percent of Firms Reporting

ANALYSIS

Fully 61% of participating companies do not have a maintenance apprentice program. This varies from 29% without Maintenance Apprentice Programs in the Primary Metal industry to 87% without such programs for the Nonelectrical Equipment group.

This significant variation in the utilization of apprentice programs may be attributed to the complexity of equipment found in different industries. The Process industries, with large amounts of complex automated equipment, require large numbers of skilled craftsmen to maintain and service these operations. One means of obtaining these skilled maintenance craftsmen is by implementing an apprentice training program.

VIII. Special Maintenance Technician Requirements

SCOPE

The sophistication of modern automated equipment demands an equal technical sophistication of maintenance personnel. In-line machines with advanced control and sensing devices permit long series of interdependent operations and also allow for more stringent operating tolerance capabilities. Downtime for this type of operation becomes extremely costly.

The following graphs present the percentage of reporting companies that use special technicians in maintenance and the ratio of maintenance hourly employees to special technicians when they are used. Special maintenance technicians are defined as those employees requiring special skills such as numerical control technicians, vibration analysis technicians and electronic maintenance technicians.

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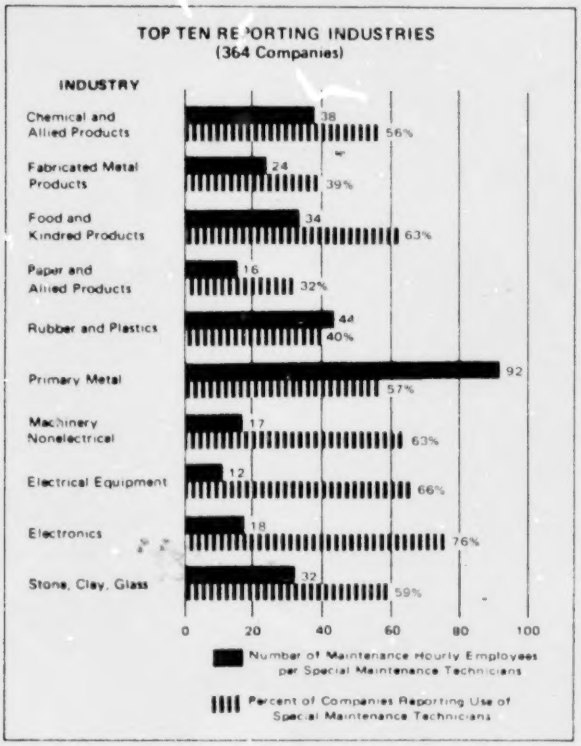

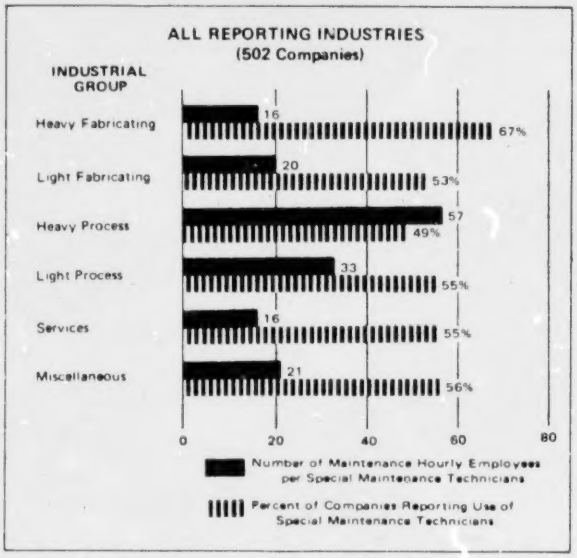

ANALYSIS

Special maintenance technicians are used in 55% of the companies participating in the survey. Where special technicians are used, the average ratio of maintenance hourly employees per technician is 33:1.

There is a substantial variation among industries in both the use of special technicians and the ratio of hourly employees per special maintenance technician. It is important to note that this variation may not reflect an actual difference in requirements for special technical skills. Many companies have upgraded the skill levels of their craftsmen rather than employ special technicians.

IX. Industrial Engineers in Maintenance

SCOPE

During the past ten years, automation, greater mechanization and rising labor and material costs have increased maintenance costs generally to the point where control is vital if companies are to stay in business. Industrial engineering principles and techniques, well proven in the production area can, if properly applied, greatly aid management in establishing this control. Methods improvement, work simplificiation, work measurement and cost controls programs can substantially improve maintenance operations.

The following graphs present the percent of companies by industries that have industrial engineers assigned to maintenance and the ratio of maintenance hourly employees to industrial engineers where used. Industrial engineers are defined as employees required to maintain and administer methods, procedures and measurement programs.

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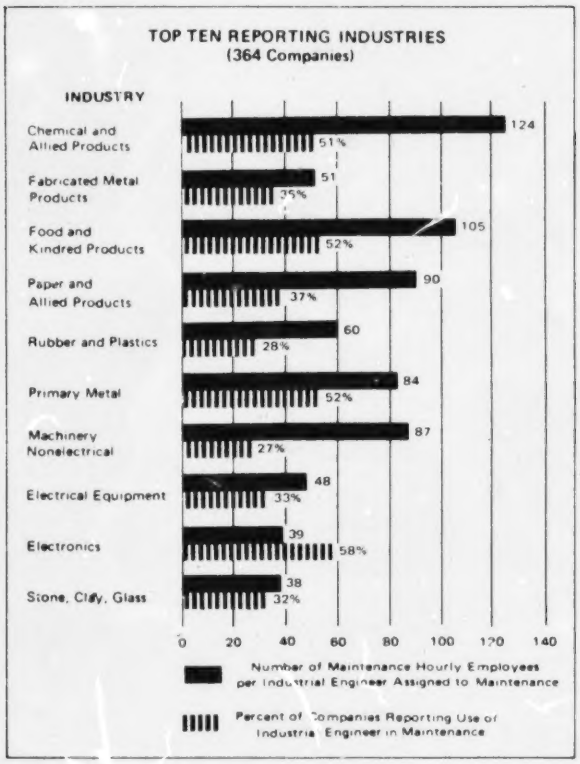
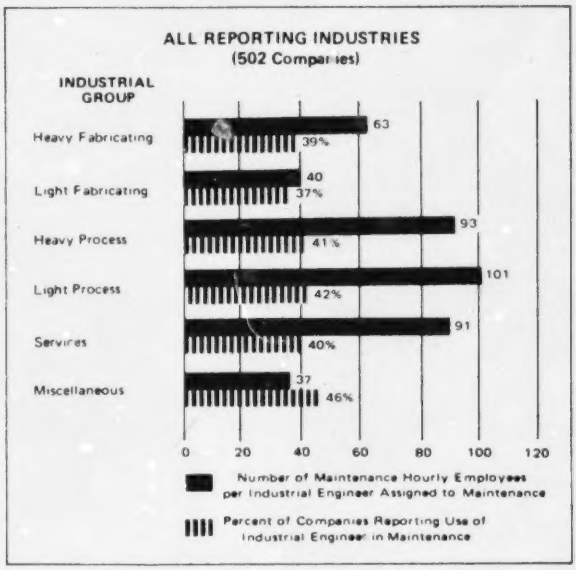




ANALYSIS

In our survey, only 40% of the companies reported having industrial engineers assigned to maintenance. The average ratio of maintenance hourly employees to industrial engineers, where used, is 67:1. There is a substantial variation among industries for both the frequency of use and the number of industrial engineers per maintenance hourly employees.

It is apparent from the data that management does not exercise the same degree of control of maintenance operations as production operations. The use of industrial engineers may, however, be somewhat higher than the data indicates. Many companies with decentralized operations, for example, do not assign industrial engineers to maintenance but provide consulting services on an as-required basis. Also the number of hourly employees an industrial engineer can effectively administer depends on the availability of support personnel such as planners, estimators and standard applicators.

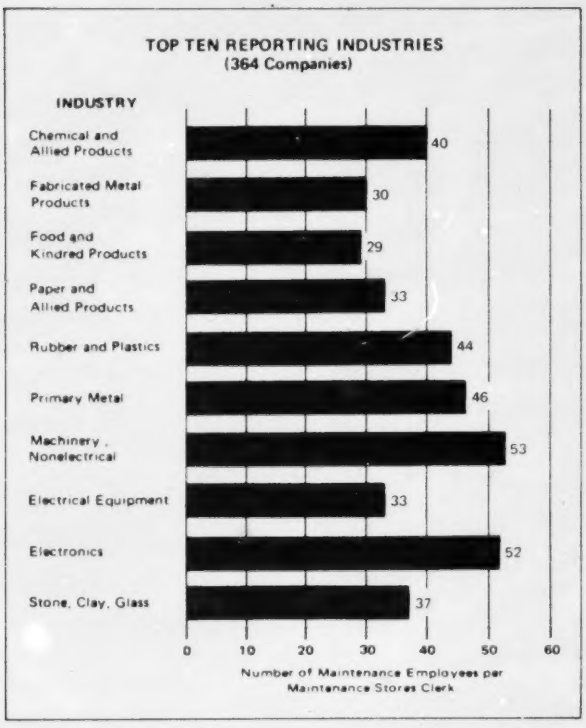
X. Maintenance Storekeeping Requirements

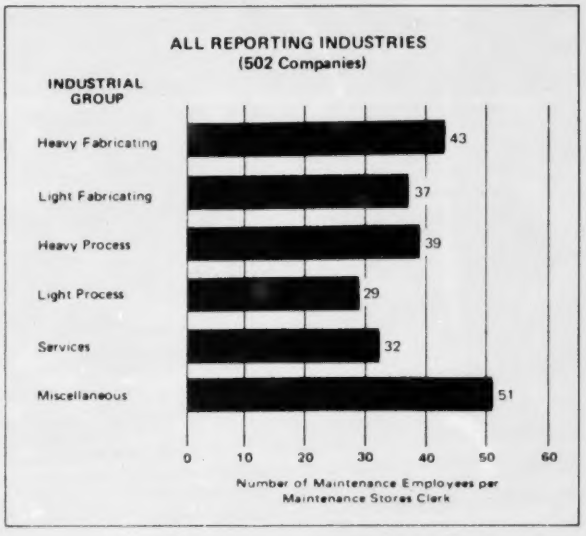
SCOPE

The proper control of maintenance spare parts, materials and supplies is an important factor in reducing maintenance costs to a minimum. In many plants there is a tendency to underestimate the importance of proper control in this area. Few people realize how often mechanics must go to the storeroom and how much this costs. A review of work orders would probably reveal that 80% to 85% of all maintenance jobs take less than two hours. Most of these jobs require at least one trip to the storeroom.

The following graphs present the average ratios, by industry, of the number of maintenance hourly employees per stores employee.

DATA





ANALYSIS

For all reporting companies, the average ratio of maintenance hourly employees per storeroom clerk is 38:1. The ratio varies from 29:1 in the Food industry to 53:1 for the Nonelectrical Machinery group.

This variation may be attributed, at least in part, to the degree of utilization of electronic data processing equipment for storeroom control. Where EDP equipment is utilized for inventory control, record keeping, and other routine clerical tasks, fewer stores clerks are usually required to service the maintenance hourly force.

For an individual company, many other factors affect the number of stores clerks that are necessary. Companies will require comparatively more stores personnel if the practice is for clerks to deliver materials to job sites. Also, how well the stores area itself has been planned will influence the number of personnel required.

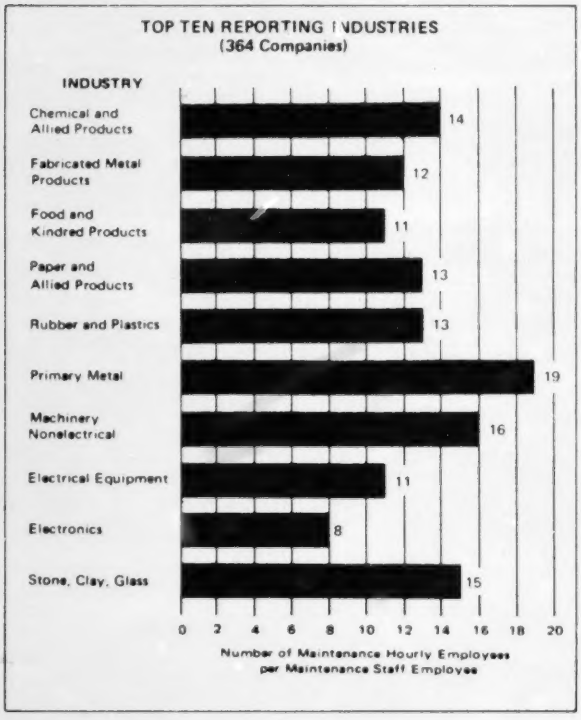
XI. Maintenance Total Staff Manpower

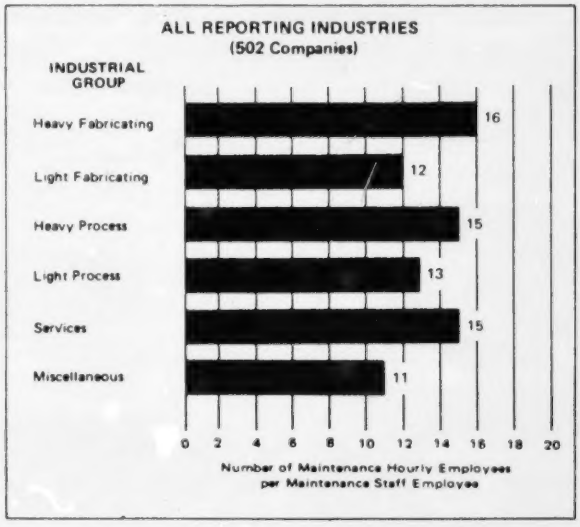
SCOPE

Management's experience with production control has proven that best results are obtained when work input control and work performance control are kept separate. The application of this concept to maintenance operations has, however, been a relatively recent development. Staff specialists in maintenance are increasingly being used to perform planning, conduct methods improvement programs, establish and administer work measurement programs and provide general advisory services to line management. As the economic advantage becomes more apparent, there will be a corresponding increase in the staff support available for maintenance operations.

The following graphs present the average ratios, by industry, of the number of maintenance hourly employees per maintenance staff employee. Included as maintenance staff are planners, clerks, stores personnel and industrial engineers assigned to maintenance.

DATA





ANALYSIS

The average ratio of maintenance hourly employees per maintenance staff employee is 14:1 for all the companies surveyed. Expressed differently, maintenance staff personnel represent 7% of the total maintenance hourly work force. The ratio varies by industry, ranging from 8:1 in Electronics to 19:1 in Primary Metal.

It is apparent from the data that the maintenance manager receives less staff support than his counterpart in production, where a ratio of direct hourly to staff employees of 7:1 is not uncommon. Of equal importance is the composition of the maintenance staff force compared to production staff. There are typically fewer control staff employees, such as planners and industrial engineers in the maintenance staff force compared to production staffs. It is the input control employees that contribute the most in improving the efficiency of direct labor utilization.

Albert Ramond and Associates
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OFFICE MANAGEMENT

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